

Notes on the treefrogs (Hyperoliidae) of North-Western province, Zambia

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This paper is based on a collection of treefrogs (Hyperoliidae) from northern Mwinilunga district, North-Western Zambia. *Hyperolius cinnamoventris* is new to Zambia, *Hyperolius kivuensis* and the doubtful *Leptopelis parvocagii* are additions for the district. *Hyperolius nasutus* and *Hyperolius benguelensis* are established as separate species based on distinct structures of their calls. *Hyperolius bocagei* is established as a synonym of a member of the *Hyperolius viridiflavus* superspecies.

INTRODUCTION

Northern Mwinilunga district in the North-Western province of Zambia stretches as a peninsula between Angola and République Démocratique du Congo, countries where biological fieldwork is difficult. This part of Zambia has therefore received considerable attention from herpetologists, and the fauna of Amphibia is reasonably well known (for treefrogs, see: SCHIÖTZ, 1975, 1999, POYNTON & BROADLEY, 1987; BROADLEY, 1991).

The present note is based on a collection made by the authors during a brief stay in the district, 11 days in November 1999. The following localities were visited (1) 2-5.11.1999, Hillwood farm (11°15'S, 24°18'E); (2) 5-6.11.1999, Zambesi rapids (11°08'S, 24°08'E); (3) 6-9.11.1999, Jimbe river (10°57'S, 24°07'E); (4) 9-11.11.1999, Kachifiwuru (10°57'S, 24°06'E).

Although before the onset of the heavy rains, it was possible to secure or observe probably all the species that have been reported from the area, with two additions to the district and one to the country. This note thus covers all species of Hyperoliidae which have been recorded from the Mwinilunga district. Only information regarded as new is given in this paper. POYNTON & BROADLEY (1987) and SCHIÖTZ (1975, 1999) gave a more general treatment. The preserved material is deposited in the Zoological Museum, Copenhagen (ZMUC).

TAXONOMY

Afrivalus wittei (Laurent, 1941)

Comments. – Abundant and conspicuous in savanna localities. All collected specimens have an identical pattern

Material. – Fishpond near Jimbe river, ZMUC R.077939-40, R.077999 (2 ♂, 1 ♀); Hillwood: ZMUC R.076676-77, R.076696, R.077926-38 (16 ♂).

Hyperolius nasutus Günther, 1864

Comments. – See remarks under *Hyperolius benguellensis*. Sixteen of the specimens (ZMUC R.77957-72) were collected when calling and could therefore be distinguished with absolute certainty from *H. benguellensis* by the voice. The remaining material is from the same ponds, where no *H. benguellensis* were heard.

Voice – A brief scream, apparently similar to the voice of this species elsewhere in its vast range (fig. 1).

Material – “Paul’s Fishpond”, Hillwood, ZMUC R.077957-83 (25 ♂, 2 ♀)

Hyperolius benguellensis (Bocage, 1893)

Comments. – The possible occurrence of a species very similar to, but distinct from, *Hyperolius nasutus* in southern Africa has long been discussed. SCHIÖTZ (1975) recognised with doubt the species *Hyperolius granulatus* (Boulenger, 1901) and so did, with similar doubt, POYNTON & BROADLEY (1987) although they used the older name *H. benguellensis*, whereas SCHIÖTZ (1999) reluctantly lumped *H. nasutus* with *H. benguellensis*.

During our field studies, we observed two structurally different voices in the study area. The two types of calls were not heard from the same breeding localities, but from localities only a few hundred meters apart.

We believe that the two call types represent two different species and that our separation of the material between the species *H. benguellensis* and *H. nasutus* is correct, also for the specimens not heard calling when collected since we spent several nights collecting in the localities and listened especially for aberrant voices. Many voices were heard, but none belonging to *H. nasutus* at a *H. benguellensis* locality or vice versa.

POYNTON & BROADLEY’s (1987) meticulous discussion of the *H. benguellensis-nasutus* group is based on the assumption that the paravertebral lines are the key characters for *H. benguellensis*. However, of our material of this species, out of 41 specimens only 6 show paravertebral lines after preservation. We are therefore not confident that POYNTON & BROADLEY’s (1987) distinction between the two species is congruent with ours.

If samples are separated according to the voices it is possible to differentiate the two species on external morphology. In mixed, preserved samples we believe that not all specimens

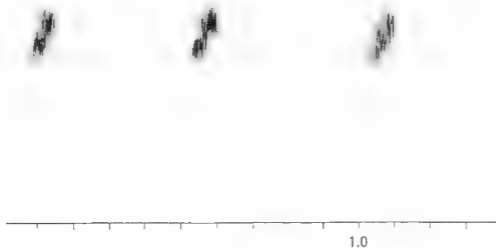


Fig. 1 – Voice of *Hyperolius nasutus*, Hillwood. The horizontal lines are 1kHz apart, the marks on the horizontal axis are 0.1 sec. apart

can be identified with certainty. The extent of webbing seems to be the best character, although the webbing of *H. nasutus* varies so much over its range that this character must be treated with caution and may be valid only in this part of Africa. The dorsal skin may be more coarsely granulated in *H. benguelensis*, but the difference is not great (see tab. 1).

Table 1. Comparison between *Hyperolius nasutus* Günther, 1864 and *Hyperolius benguelensis* (Bocage, 1893).

<i>Hyperolius nasutus</i>	<i>Hyperolius benguelensis</i>
Characters in life Translucent green No paravertebral lines Sometimes fine middorsal line Voice a scream	Often darker green Sometimes paravertebral lines No middorsal line Voice a brief rattle
Characters after preservation Ground colour lighter Nares less protruding More webbing Dorsum finely granulated	Ground colour darker Nares more protruding Less webbing Dorsum more coarsely granulated

WILSON (in press) discovered a degeneration in the tympanic apparatus in *H. benguelensis*, a character not found in *H. nasutus*. She kindly examined our material of both species and found the difference in tympanum consistent with our separation.

In spite of the degeneration of the tympanic apparatus, the presence of a voice seems to imply that *H. benguelensis* is not deaf. HETHERINGTON & LINDQUIST (1999) pointed at alternative hearing mechanisms.

H. benguelensis is similar in colour pattern to *Hyperolius viridis* Schiøtz, 1975 from south-western Tanzania. *H. viridis* is, however, a larger frog (male snout-vent length 22-26 mm vs. 17-22 mm in *H. benguelensis*) and especially a much more massive, broader frog, similar in body proportions to the smaller *Hyperolius pusillus* (Cope, 1862).

Colour in life. – Translucent green, sometimes darker, more “dense” green. Many specimens have a pair of light dorsolateral lines, and an additional, more diffuse pair of paravertebral lines (fig. 3a). Other specimens lack the paravertebral lines, and some also lack the dorsolateral lines and have diffuse dark spots on dorsum (fig. 3b). The latter two morphs seem inseparable in pattern from *H. nasutus*, although they are sometimes somewhat darker.

Breeding. – The eggs have a white and a dark greenish pole.

Voice. – A brief rattle, acoustically quite distinct from the voice of *H. nasutus*. The sonogram (fig. 2) shows a brief series of rather indistinct figures at 4000-4200 Hz. The voice illustrated in SCHIÖTZ (1975: fig. 96) from Kabwe (Zambia) as that of *H. nasutus* is in fact that of *H. benguelensis*.

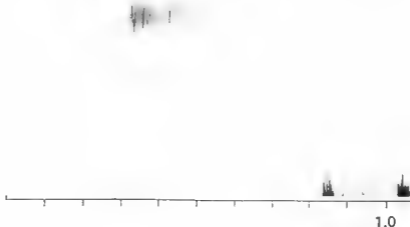


Fig. 2. Voice of *Hyperolius benguelensis*, Hillwood

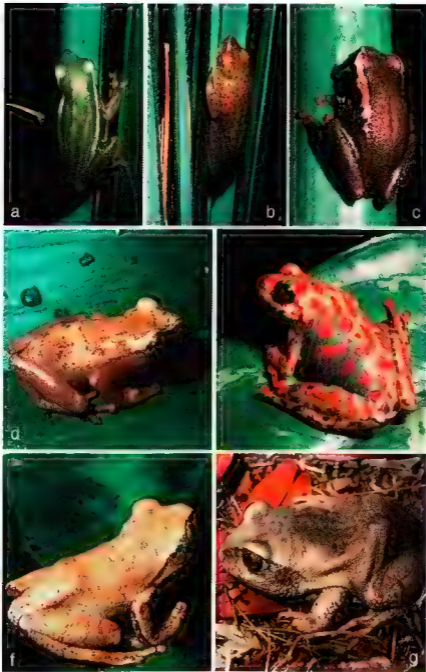


Fig. 3. (a, b) *Hypocolinus banguelensis*, Hillwood. (a) specimen with paravertebral lines, (b) spotted morph. (c, d) *Hypocolinus major*, Kaohiwiru. (c) phase 2, (d) phase 1. (e) *Hypocolinus paralichis albonifus*, ♀, Hillwood. (f) *Leptopelis cymamometus*, ♂, Zambesi rapids. (g) *Leptopelis parboagui*, ♂, Zambesi rapids.

Only few calling populations of *H. nasutus* and *H. benguellensis* were heard, so no conclusions in relation to habitat preference could be drawn. The two species were not heard at the same localities. While *H. nasutus* was heard in old, partly overgrown fishponds with much low vegetation, *H. benguellensis* was taken in more open water holes on the grass-covered plains at Hillwood. These last localities would seem to be similar to localities with *H. nasutus* from other places in Africa.

Of the present material, 10 males were taken when calling (ZMUC R.076709-18).

Material. – Hillwood: ZMUC R 076709-49 (35 ♂, 6 ♀)

***Hyperolius quinquevittatus* Bocage, 1866**

Comments. No breeding activity was observed. The specimens were taken by chance far from water. Some of the specimens have a pattern which differs somewhat from that hitherto recorded for the species: in life dorsum brown with three conspicuous golden-green bands (i.e. a middorsal and two lateral bands), delimited with dark brown lines. Although it is in principle the same pattern as e.g. that shown in SCHIÖTZ (1999: fig. 175), the general impression is that of a dark frog with 3 light stripes.

Material. Kachifwiru: ZMUC R.771016-19 (4 ♂); Hillwood: AMUC R.076707, R.771104-05 (2 ♀, 1 juvenile); Zambesi rapids: ZMUC R 076750 (1 juvenile).

***Hyperolius kivuensis* Ahl, 1931**

Comments. – Only a single male collected.

Material. – Kachifwiru: ZMUC R.0771015 (1 ♂).

***Hyperolius parallelus alborufus* Laurent 1964**

Comments. A member of the *Hyperolius viridiflavus* superspecies. The species structure within this group is unsettled and disputed. The present form is conventionally included in the species *Hyperolius narmoratus* Rapp 1842, whereas SCHIÖTZ (1971, 1975) has argued for its inclusion in the species *Hyperolius parallelus* Günther, 1859.

The type series from Cazombo (Angola) has black dots round the anus and on the tarsi. Such spots are absent in the present sample. The form *alborufus* is very similar to other forms in the very variable complex from this part of Africa, and a detailed study of the variation would seem rewarding.

The present collection shows great uniformity in pattern as all specimens of the female phase have the pattern shown in figure 3e. It is remarkable that a sample collected by Ronald Keith, also from the Mwinilunga district, shows much variation in pattern (see SCHIÖTZ, 1971: fig. 13, 1975: fig. 181, 1999: fig. 474a-e). This may be due to selective collection by Keith. Our sample was collected without any bias as to pattern. Also the sample reported in BROADLEY (1991) shows little variation (Broadley, in lit.).

Breeding activities had hardly started during our visit, and only a few males were calling from the ponds. There was, however, quite a number of males calling widely scattered in the rather dense Miombo woodland in the area, apparently while migrating towards water. The voice emitted here was the coarse "initial sound" and only a few times was the melodic breeding call heard. Males and females collected there and kept in plastic bags did not produce eggs during the night, something that would always happen if collected on the breeding site.

Colour in life In life, all phase F specimens had a bright red vermiculation on a light, greyish background. Females had a bright red ventrum and conspicuously blue subdermal lateral band (for explanation of this term, see SCHJØTZ, 1999: 199). The males of phase F were similar, but with a less conspicuous subdermal lateral band. Males of phase J were brown with a darker hour-glass pattern.

Material – Fishpond near Jimbe river: ZMUC R.771000-03, R.771045-47 (6 ♂, 1 ♀), Hillwood: ZMUC R.076683-95 (10 ♂, 3 ♀).

Hyperolius major Laurent, 1957

Comments – Described as a subspecies of *Hyperolius platyceps* (Boulenger 1900) but regarded as a full species by SCHJØTZ (1975), mainly because the status of the name *H. platyceps* was unclear. *H. platyceps* has later been defined (AMÉL, 1978; SCHJØTZ, 1999). In morphology and pattern, the present taxon is very similar to *H. platyceps* from north-western Central Africa. It is here regarded as a full species because the voice differs from that of *H. platyceps*.

Colour in life Two phases. Phase 1: dorsum light brown with a darker hour-glass pattern; very dark loreal area, continuing behind the eye, the light pattern forming a triangle on the snout (fig. 3d). Phase 2 (presumed female phase): dorsum uniform brown with light canthal and dorsolateral stripe, also extending over upper eyelid (fig. 3c). Both phases: arms and legs dark brown, in some specimens with conspicuous small light spots. Many specimens have similar light spots in the dark pattern. Ventrums and throats orange. Ventral side of limbs darker orange. The single female collected is of phase 2, brown with a lighter brown lateral stripe.

Breeding Found exclusively in the dense gallery forests, thus being a "farmbush form" or "bushland form" according to the terminology of Schjötz, collected together with *Leptopelis cynnamomeus* (Bocage, 1893).

The eggs have a white and a black pole.

Voice An initial coarse creak, followed by a series of hard, unmelodic clacks in rapid succession, almost *Afitivalus*-like (fig. 4). Such a vocal structure, with elements in a measured rhythm, is quite unusual in the genus, found in *Hyperolius guttulatus* Günther, 1859, *Hyperolius tuberculatus* Mocquard, 1897, *Hyperolius pseudargus* Schjötz & Westergaard, 1999 and a few others. The sonogram of *H. major* in SCHJØTZ (1999, fig. 400) is of the initial creak.

Material Kachifwira: ZMUC R.771025-37 (12 ♂, 1 ♀); Jimbe river: ZMUC R.771038-44 (7 ♂).

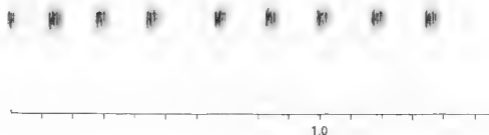


Fig. 4. – Voice of *Hyperolius major*, Kachifwiru.

***Hyperolius kachalolae* Schiøtz, 1975**

Comments. The present samples differ somewhat from the small sample from the type locality. After preservation they have a more baggy, often pigmented gular sac, and in life the sac is yellow to black, not turquoise as in the types. Nevertheless we are convinced that the specimens listed here are conspecific with *H. kachalolae*. The voice is the same, and the thin red canthal- and dorsolateral lines seem diagnostic.

One of our samples (from granite outcrops near Zambesi rapids) differed in life somewhat from the other samples, mainly in the absence in most specimens of red canthal and dorsolateral lines, and with a large proportion of the males being very dark and with a black gular sac. We were in doubt as to whether two species were involved, but after preservation it is impossible to distinguish that sample from the rest as especially the lighter specimens show red canthal and dorsolateral lines, sometimes very faint, also the voice is identical to that of the other samples of *H. kachalolae*.

POYNTON & BROADLY (1987) expressed doubt as to whether *H. kachalolae* is different from *Hyperolius bocagei* Steindachner, 1867. The senior author has examined the holotype of *H. bocagei* (Naturhistorisches Museum Wien, NMW 14846), a surprisingly well preserved, large female (35.1 mm) with a well-developed gular fold and extensive webbing. These characters, and the white, "chalky" dorsal surfaces, make it certain that it is a member of the *Hyperolius viridiflavus* superspecies as suggested in SCHIÖTZ (1999). Neither the imprecise type locality (Angola) nor the pattern of the type (chalky white, as normal in the dry season) permit reference to a specific subspecies in the complicated *H. viridiflavus-marmoratus-parallelus* group, so no nomenclatorial change based on priority seems necessary.

H. bocagei has been recorded from a number of localities in Angola, southern R. D. Congo and northern Zambia, and *H. kachalolae* so far only from the type locality. Since *H. kachalolae* is abundant and very conspicuous in the Mwinilunga district in fact the dominant *Hyperolius* -, it seems unlikely that it has not been collected in neighbouring Angola and southern R. D. Congo, nor being found in the material referred to as *H. bocagei* in POYNTON & BROADLEY (1987). According to the description especially the last could well be *H. kachalolae*. There are some samples in museums of members of the *H. viridiflavus* group identified as *H. bocagei* by R. F. Laurent (see SCHIÖTZ, 1999: 188).

In conclusion, *Hyperolius bocagei* is a synonym of one of the members of the *H. viridiflavus* superspecies whereas we believe that several later records of *H. bocagei* in the literature refer to *H. kachalolae*.

Colour in life Males: dorsum green to straw-coloured to black with red fingers and toes. Some populations have a conspicuous red canthal line, continuing behind the eye, often as spots. Many specimens in other populations lack the red lines in life. Gular sac in males from yellowish to black, the latter especially in the black-backed specimens.

Females bright orange (our observations) or tomato red (Channing & Drewes, in lit.). Some females have a feebly developed transversal gular fold.

Material. - Fishpond, Jimbe river: ZMUC R.0.77948-52, R.771048-67 (15 ♂, 10 ♀), Zambesi rapids: ZMUC R.077953-57, R.077968-078003 (39 ♂, 1 ♀); Kachifwiru: ZMUC R.771020-24 (5 ♂); Hillwood: ZMUC R.076678-79, R.076697-706 (11 ♂, 1 ♀).

***Hyperolius cinnamomeiventris* Bocage, 1866**

Comments. First record from Zambia, but not unexpected in view of its range. No calling heard.

Material. - Hillwood: ZMUC R.771012-14 (2 ♂, 1 ♀)

***Kassina senegalensis* Duméril & Bibron, 1841**

Comments. All collected specimens belong to the strange spotted, rather large morph (see photo in SCHIÖTZ (1999: fig 508), except one with an almost unbroken dorsal line.

Material. - Zambesi rapids: ZMUC R.77986-91 (4 ♂, 2 ♀), Hillwood: ZMUC R.771009-11 (3 ♂); Jimbe river: ZMUC R.076665 (1 ♂).

***Kassina kuvangensis* (Monard, 1937)**

Comments. - The characteristic voice, quite different from that of *K. senegalensis*, was heard at an overgrown fishpond at Hillwood. No specimens could be collected. We did not hear the two species of *Kassina* from the same locality.

Kassinula wittei Laurent, 1940

Comments – This tiny frog was quite common on the soggy, grass-covered rocks near the Zambezi rapids, but it was difficult to track down.

Material. Granite flats, Zambesi rapids: ZMUC R 77984-85 (2 ♂).

Leptopelis cynnamomeus (Bocage, 1893)

Comments. – This species was suggested to be one of the “savanna screamers” in SCHIÖTZ (1999), a somewhat flippant term for a group consisting of vicariating savanna forms with a similar morphology and a very characteristic voice, but rather different patterns. We believe that some members of this group (*Leptopelis concolor* Ahl, 1929; *Leptopelis argenteus* (Pfeffer, 1893); probably *Leptopelis broadleyi* Poynton, 1985) are closely related, probably at the subspecies level, but cannot maintain *L. cynnamomeus* as a member of this group. It is not a savanna form, but a bushland form. It has feebly developed pectoral glands (absent in the other forms), and the voice is audibly different from them.

Colour in life. Golden brown with diffuse, darker transverse bands and a dark interorbital streak. Loreal area dark (fig. 3f).

Voice. Calling from leaves, often several meters up, in dense riverine (gallery) forests. Voice a scream followed by 2-3 quiet clacks (“yim-clack-clack”), sometimes clacks alone. See sonogram in SCHIÖTZ (1999: fig. 681).

Note – In the distribution map of “the savanna screamers” in SCHIÖTZ (1999: fig. 672), the symbols for *L. argenteus* and *L. broadleyi* have unfortunately been switched.

Material – Kachifwira: ZMUC R 77992-97 (5 ♂, 1 ♀), Zambesi rapids: ZMUC R 771004-08 (5 ♂); Jimbe River: ZMUC R.076666-75 (8 ♂, 2 juveniles).

Leptopelis parbocagii Poynton & Broadley, 1987

Comments – POYNTON & BROADLEY (1987) established the species *L. parbocagii* with hesitation, since the difference from *L. bocagii* (Gunther 1864) seems very small. Their key character is the broader head of *L. parbocagii*, expressed as the ratio interorbital distance vs. nostril-tympanum being greater than 36%. We are indebted to J. C. Poynton for having examined our material and confirmed that it falls well within the definition of *parbocagii* (♀ 37.5%, ♂ 39.1-47.6%), but we agree with Poynton & Broadley that *L. parbocagii* may not be a species distinct from *L. bocagii*.

L. parbocagii is so far unrecorded from this area. *L. bocagii* is recorded from Isombo Stream (POYNTON & BROADLEY, 1987; BROADLEY, 1991) and Hillwood, (BROADLEY, 1991). We have examined the material reported in BROADLEY, 1991 (8 specimens from Hillwood, 1 from Isombo Stream). They seem to fall within the definition of *L. parbocagii*, with an interorbital distance vs. nostril-tympanum of 36.8-50.9%.

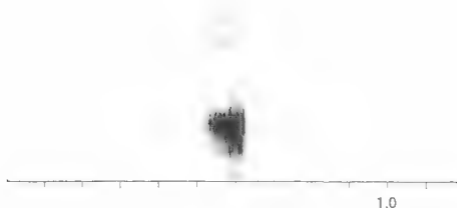


Fig. 5. – Mating call of *Leptopelis parvocagii*, Zambesi rapids.

All our specimens were taken in the savanna. The males from Jimbe River were calling in a cultivated field close to the gallery forest. Some males were calling from the ground, others from a low height in bushes.

Colour in life. – Dorsum grey to brown, often with a darker, almost black blotch on the dorsum (fig. 3g).

Voice. – A deep, atonal “*waub*”, possibly indistinguishable from the voice of *L. bocagei* (fig. 5). As in several other *Leptopelis*, another call (territorial?) is sometimes heard, namely a long succession of clacks, almost inaudible at first but growing in intensity until the call ends with the usual clack. One such recorded call (fig. 6) has a total duration of 8 seconds.

Material. – Near Jimbe River: ZMUC R.77942-44 (5 ♂), Hillwood: ZMUC R.77945 (1 ♀), Kachifwiru: ZMUC R.77946-47 (2 ♂).

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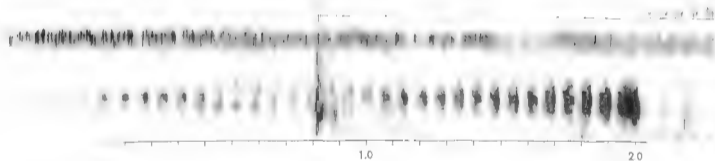


Fig 6 Presumed territorial call of *L. parvocornis*, Kachifwiru. Only the last 2.3 seconds of the call with a total duration of 8 seconds is shown. The call is the succession of figures with growing intensity seen between 1 and 2 kHz.

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